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MADROÑO

A WEST AMERICAN JOURNAL OF BOTANY

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CYTOLOGICAL EVIDENCE FOR THE TAXONOMIC POSITION OF SCHIZACHNE PURPURASCENS

W. S. BOYLE

During a cytotaxonomic study of the genus *Melica*, it became necessary to investigate the status of *Schizachne purpurascens* to determine whether or not it should be included in the genus *Melica* or whether it should be treated as a separate genus as suggested by Swallen (4). The natural relationships of the monotypic genus *Schizachne* Hack. have long presented a problem to students of the Gramineae. During the course of its taxonomic history, *S. purpurascens* has been placed in *Avena*, *Trisetum*, *Melica*, and *Bromelica*.

From the morphological standpoint, *Schizachne* shows considerable affinity with *Melica*. The possession of sterile florets at the apex of the spikelet, weak glumes, rounded lemmas, fleshy truncate lodicule, dichotomously branching stigmas, and free caryopses are admittedly indicative of close relationship to *Melica*. *Schizachne* differs from *Melica* in the presence of long bristly hairs on the callus and in its divergent awns.

The karyotype of *Schizachne purpurascens* has now been studied and compared with those of *Melica* species. Specimens of *S. purpurascens* collected near Providence, Rhode Island, were supplied through the kindness of Dr. G. L. Church of Brown University. Seed of *Melica imperfecta* from San Benito County, California, was provided by Dr. G. L. Stebbins, Jr., of the University of California. Root-tips of these were killed and fixed according to Randolph's (1) modification of Navashin's fixative, sectioned at 10 microns, and stained with gentian violet. All of the species of *Melica* thus far investigated possess nine pairs of relatively large chromosomes with considerable difference in their length and in the position of the centromere (fig. 1a). This remarkable uniformity of the chromosome complement among the species of *Melica* was first noted by Stebbins and Love (3). *Schizachne purpurascens*, on the other hand, possesses ten pairs of small chromosomes with little difference in size and all with median to submedian centromeres (fig. 1b). The contrast in number and morphology of the chromosomes in addition to the external morphological differences between *Schizachne* and *Melica* provides ample evidence, in the writer's opinion, for the exclusion of *Schizachne purpurascens* from the genus *Melica*.

Swallen (5) suggested that the genus *Amphibromus* is most closely related to *Schizachne*. On morphological grounds (the cytology of *Amphibromus* is not yet known) this does not seem very plausible as the thin, lanceolate lodicules and the pubescent caryopses of *Amphibromus* would seem sufficient to separate it from the genus *Schizachne*. This viewpoint is furthered by a con-

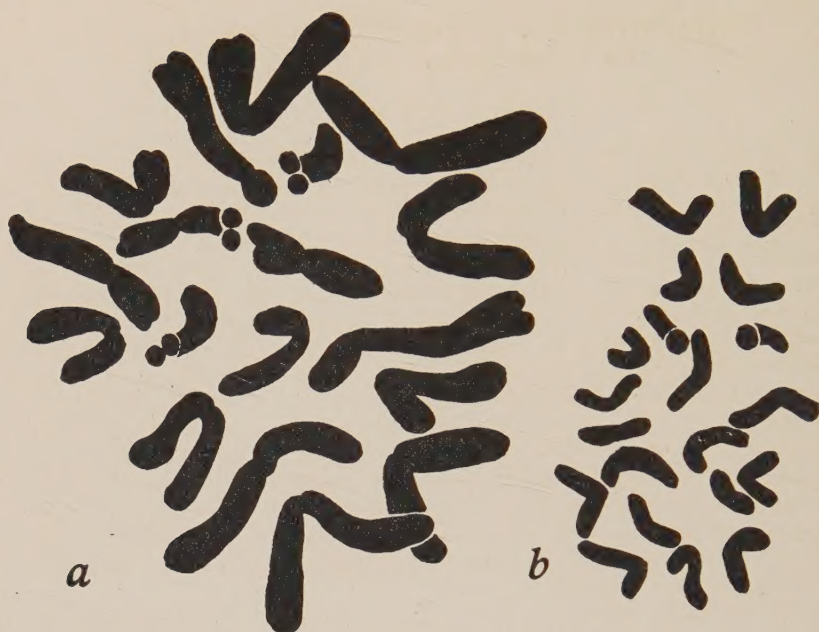


FIG. 1. Karyotypes of *Melica* and *Schizachne*. *a*, *Melica imperfecta*, $2n=18$; *b*, *Schizachne purpurascens*, $2n=20$. (Drawings made with camera lucida at a magnification of $5000\times$ and reproduced at $3000\times$.)

sideration of the fact that *Amphibromus* is confined to Australia and South America, while *Schizachne* is found only in the northern hemisphere.

Skorniakov and co-workers (2) have suggested that *Schizachne*, *Melica*, *Glyceria*, *Pleuropogon* and *Anthochloa* be segregated as the tribe *Melicineae*. This viewpoint has much to recommend it; the relationships of *Schizachne* in all probability lie with the above genera.

The author is glad to acknowledge assistance from Dr. G. L. Stebbins, Jr., in this study.

Department of Botany,
University of California, Berkeley,
November, 1943.

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NOTEWORTHY PLANTS OF TEXAS. II. A
NEW SPECIES OF PELTANDRA

FRED A. BARKLEY

In a rather inaccessible portion of the sandy oaklands of Robertson County, eastern Texas, is a bog nearly a kilometer long which varies from a few meters to over a hundred in width. At its upper limit the bog has dried sufficiently so that a grass-sedge meadow separates it from the woodland. The peat of the bog varies from a few inches in depth at the upper end to nearly twelve feet near the lower end. This bog apparently overlays a previous peat deposit, since erosion of the stream a short distance below the bog shows over seven feet of old peat exposed under the sand. The dominant species of the bog is *Sarracenia Sledgei* Macf., which occurs in profusion in it in contrast to other bogs which the author has visited in Texas where this species is either absent or at least not abundant. Many of the plants abundant in other bogs in this area, *Utricularia*, *Iris*, *Xyris*, and *Eriocaulon*, are present here in great profusion; also growing here are *Sparganium*, *Aletris*, *Dulichium*, and *Hypoxis humilis*, none of which is frequent in this area.

In a swamp along the brook above the bog and again in more abundance along the streamlet running through the bog, especially near the lower end, a plant occurs which apparently is an undescribed species of *Peltandra*. A description of this plant follows.

*Peltandra Tharp*¹ sp. nov.

Herbacea perennis acaulescens; cormis circa 4.5 cm. longis, 6 cm. latis; foliis erectis, numerosis, lanceolatis, sagittatis, acutis vel acuminatis, subintegris vel integris, lobis ad basin angustis, plus minusve acutis, subpeltatis, petiolis $35 \pm$ cm. longis, ad basin vaginatis; scapis $20 \pm$ cm. longis, recurvatis; spathis viridibus, 3.5–4 cm. longis, 1.5–2.5 cm. latis.

¹ Benjamin Carroll Tharp, born November 16, 1885, at Pankey, Grimes County, Texas, son of Angelina M. A. Jenkin and Edwin Harris Tharp, married Norris Wallis of Rockdale, Texas, September 16, 1914. Two sons: Benjamin Carroll, Jr., September 3, 1919, and George Edwin, December 9, 1921. A.B., University of Texas, 1914, A.M., 1915, Ph.D., 1925. Associate professor of biology at Sam Houston Teacher's College 1917–1919; at the University of Texas since 1919, instructor 1919–1920, adjunct professor 1920–1925, associate professor 1925–1933, professor since 1933, director of the herbarium since 1942.

For over twenty years he has directed the work in ecology and taxonomy at the University of Texas where he has been the inspiration and close friend of many students. As an ecologist he has worked on the vegetation of Texas especially in the range lands, served as scientific expert in the Oklahoma-Texas boundary suit, and made other important contributions. Probably his outstanding scientific contribution is in the field of plant taxonomy, where his work on the flora of Texas rightfully places him as dean of Texas plant collectors.

"University of Texas Herbarium Biographical Sketch II"—Fred A. Barkley

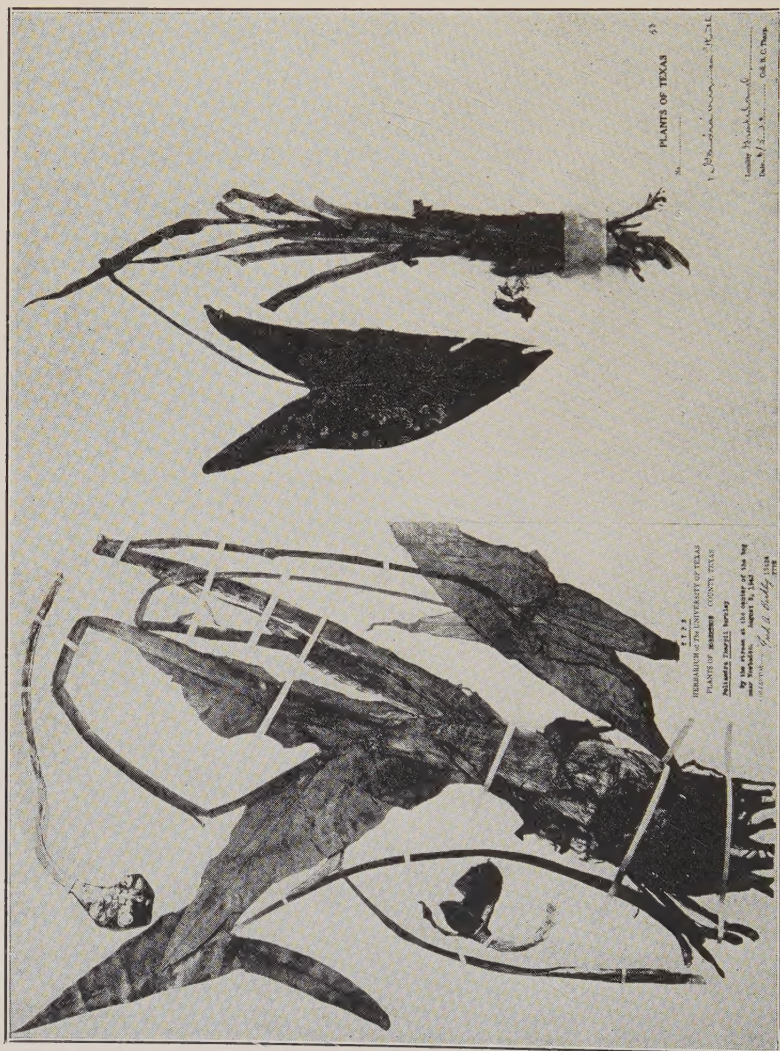


PLATE 21. PELTANDRA IN TEXAS. (Left) *Peltandra Tharpii*; (right) *Peltandra virginica*. Compare size and shape of spathe and leaf.

Acaulescent perennial with numerous, basal, erect, long-petioled, bright dark green leaves from a large corm, petiole sheathing below, slender above, $3.5 \pm$ dm. long, blades about 20 cm. long, lanceolate, sagittate, acute to acuminate, subentire, basal lobes narrow, subacute, slightly united, lateral nerves spreading, marginal nerves prominent; scapes about half as long as the petioles, recurving; spathe green, 3.5–4 cm. long, 1.5–2.5 cm. broad, completely enveloping the spadix which is adnate to it for nearly half its length, upper portion staminate, lower pistillate; fruits slightly angled, $.7 \pm$ cm. broad, $1 \pm$ cm. long.

Vegetatively this plant is very similar to *Peltandra virginica* (L.) Kunth, but differs in the larger narrower leaves, the shorter scape, and in the much shorter and broader spathe.

Specimens examined. TEXAS. Robertson County, in bog near New Baden: June 17, 1943, *Barkley 13043*; by stream at center of bog, August 8, 1943, *Barkley 13424* (type, cotypes widely distributed); marsh along stream one-quarter mile above bog, August 12, 1943, *Painter, Waldorf & Barkley 13425*; in water six inches deep in stream thru bog, October 30, 1943, *Tharp, Brady & Barkley 13698*. All of the above cited specimens are in the University of Texas Herbarium.

The Herbarium,
Department of Botany and Bacteriology,
University of Texas, Austin,
November 26, 1943.

A MONOGRAPH OF THE NORTH AMERICAN SPECIES OF FRITILLARIA

DOROTHY E. BEETLE

The genus *Fritillaria* belongs to the tribe *Tulipeae* of the Liliaceae. Its members, confined to the North Temperate Zone, are found in the Old World throughout Europe, in the northern part of Africa bordering the Mediterranean Sea, Northern Asia and as far south as Persia, Afghanistan, the Himalayas, China and Japan. In North America *Fritillaria* occurs along a narrow coastal strip from the Aleutian Islands to Northern Mexico, extending inland in the Northern United States to the western Dakotas and Nebraska.

Although the number of European and Asiatic specimens seen has not been large, it appears that in the Old World *Fritillaria* is comprised of two sections based on bulb characters and having a racemose inflorescence, and a third section with a single species, *F. Imperialis*, which has a pseudumbellate inflorescence. The majority of the Old World species of *Fritillaria* have a tunicate bulb, the rest having a large perennial squamose bulb without a tunic which is hardly distinguishable from that of *Lilium*. The bulb of the North American species, on the other hand, is a round flat disk without an outside tunic and is covered with moderate-

or small-sized scales. The North American species comprise the section *Liliorhiza* and are geographically centered in California. With the exception of *F. camschatcensis*, which occurs also in Asia, all of the members of the section *Liliorhiza* are American.

The species of *Fritillaria* are quite hardy and occur over a wide range of climate and habitat. About half of them prefer moderate shade in the woods, but are capable of growing in exposed positions near the sea, in the rocky soil and intense sunlight common to chaparral, and on dry slopes under pines. These are slender-stemmed plants, bearing their leaves in whorls and usually having a bulb with a few scales surrounded by rice-grain bulblets. The remaining species prefer the full sun and clay, loam or serpentine soils. In general they are short plants with the leaves confined to the lower half of the stem and with bulbs of fleshy scales of varying sizes. Half their number is restricted to the Great Valley of California and surrounding foothills; none of these occur over a wide area. Hutchison (11, p. 98) has suggested that the *Tulipeae* ecologically is a climax or subclimax group, pointing out that the bulbous character is a climax habit adapted to otherwise destructive climatic conditions.

Fritillaria is of little known economic importance. Its species can, with care, be cultivated as ornamental garden plants. The bulbs, which are crisp, starchy, and without flavor, were eaten by the American Indians. Hooker (8) says of the bulbs of *F. camschatcensis* that "voyagers to Kamschatka bring home small white esculent roots, dried on strings; these are the bitter tubers of this fritillary, which are also copiously eaten by the Indians of Stikine and known by names of Koch or Northwest Rice; but Mr. Tolmie says they are bitter and nauseous." On a specimen from Khutze Inlet, British Columbia, in the University of California Herbarium (McCabe 3483), Mr. McCabe notes that where this species is abundant along the coast, flocks of wild geese dig up the earth in search of the bulbs. Hogs, deer and other wild animals eat the bulbs or plants.

CYTOLOGY AND MORPHOLOGY

Fritillaria is closely allied in morphology and cytology to the other genera in the *Tulipeae*. As in the majority of the tribe, the basic haploid chromosome number is 12, with variations ascribed to polyploidy, fragmentation and fusion of some chromosomes (4, p. 80). The many species, some with a wide distribution and wide adaptation to many ecological conditions, the polyploidy and highly polymorphic nature of several species, indicate a genus near its peak of speciation. Hybridity has been observed only rarely in the field and appears to have been of little or no importance in the development of the evolutionary pattern; no instances are known of the production of hybrid swarms which obscure the identity of the parent species.

In this study, cytological evidence was used where available and an attempt was made to evaluate geographical and ecological factors. The species concept adopted is sufficiently broad to include within the species such autopolyploids as differ only quantitatively from the species and which have not established a distinct range. Following precedent in the genus, the term variety is employed when necessary.

In *Fritillaria lanceolata*, the perplexing variations present necessitated more detailed study. Statistical studies of both living and dried specimens were made to determine whether or not measurements of the plant, of the leaf, flower, pistil, anthers, pollen cells and stomata showed sharply defined size categories that could be used to separate suspected polyploids from diploids. No hiatus appeared, the measurements of each group merging completely into those of the others. Field studies, however, disclosed several cases of polyploidy. An individual plant, having a basic chromosome number of $x = 12 + 4$ fragments and showing irregular division with many bridges, was found in a normal diploid colony near St. Mary's College, Contra Costa County, California. At Alamo, in the same county, a colony under a stand of *Quercus agrifolia* and *Umbellularia californica* along a small stream proved to have diploid plants near the stream and triploid plants, $3x = 36$, twenty feet higher on the bank. Except that the ground was probably more moist where the diploid plants occurred, the habitat appeared approximately the same for these two groups. In San Mateo County, California, Stebbins collected the only tetraploid plant of *F. lanceolata* known to date. It was four feet tall and occurred in a colony of diploid plants two and one quarter to three feet tall. Such field observations and a careful study of herbarium specimens, in conjunction with cytological studies, make it evident that triploids and tetraploids occasionally occur in a normal diploid colony. None of the polyploids were found to occupy a separate range but have remained as members of the parent colony, thus adding to its diversity.

The perpetuation of much of the diversity of the species is due to asexual propagation by bulb offsets. *Fritillaria lanceolata* occurs nowhere in great abundance, but rather in many isolated stations throughout its range and any viable mutation appearing in a small colony has a fair chance of survival. Many of these local variants which have been asexually perpetuated have been described as new species.

Plants of *F. lanceolata* growing in moist, well-shaded but open situations tend to be very tall with correspondingly large, pale greenish-yellow and inconspicuously marked flowers. In very deep shade the flowers assume an almost vegetative pale green lacking any mottling whatsoever. If the plants are well protected or crowded by other plants in the woods, they are usually reduced in stature with a corresponding decrease in flower size.

On the other hand, where *F. lanceolata* is found growing in the open, in dry soil and in full sunlight, the plants will be short with smaller, predominantly purple and heavily mottled flowers. Examination of both fresh and dried material of *F. exima* Eastwood from Butte County, California, leaves no doubt that it is a very dark-flowered, many-spotted, short form of *F. lanceolata* occupying comparatively exposed localities. Along the seacoast in Marin and Sonoma counties, in places exposed to the wind or salt spray, occurs what has been called *F. lanceolata* var. *tristulis* Grant. These plants are short and stubby, two inches or more tall, with large flowers barely mottled and purple. Toward the interior, the plants increase in stature until they attain a size considered to be typical of the species.

The leaves in *Fritillaria lanceolata* may be long or short, linear or ovate-lanceolate, and this range of variation in the leaves may be found in both tall and short plants with no evident correlation with the habitat.

Tall plants usually have a raceme of from eight to thirteen flowers while short plants may have only one flower. The perianth segments may be ovate to oblong with inner and outer segments quite similar in form. The lanceolate gland is consistently definite in outline but its color varies according to that of the flower and may be inconspicuous in pale flowers.

There is some sterility in the species. Flowers are occasionally found in which the pistil remains undeveloped. Anthers have always been found to be fully developed, but the amount of fertile pollen produced varies, the lowest percentage occurring in the triploids.

It would seem that the *Fritillaria lanceolata* complex is a system of ecotypes in which the various habitats have developed their own races within the species. It would only add to the confusion to recognize each one of the more stable forms as specifically distinct. A basis for the interpretation of this complex is afforded by the realization that *F. lanceolata* is today an actively differentiating species occupying several ecological situations and perpetuating its many variations by asexual reproduction.

Fritillaria pudica is a complex which Gandoger (7) divided into six species on the basis of flower color, size and leaf characters. Turrill (21) reports that plants of this species, grown in the Royal Botanic Gardens, Kew, showed, in various combinations, all the characters employed by Gandoger. Herbarium specimens examined indicate that the species ranges from three to fourteen inches in height, the short plants in general being slender with short linear leaves, although a few are stout with oblanceolate leaves, and those ten inches or more in height usually having a thick stem and oblanceolate leaves, although they may be slender with linear foliage. Larger plants have large flowers and capsules, but the perianth segments are remarkably uniform

TABLE 4. Chromosome numbers in *Fritillaria*. Unless otherwise noted, these counts were made during the course of this study.

Species	Chromosome number	Locality
<i>F. camschatcensis</i>	n = 12, 18	Matsuura (15)
<i>F. folcata</i>	n = 12	Red Mountains, Mount Hamilton Range, Santa Clara County, California
<i>F. lanceolata</i>	n = 12	Moraga Ridge, Contra Costa County, California
<i>F. lanceolata</i>	n = 12, 18	Alamo, Contra Costa County, California
<i>F. lanceolata</i>	n = 12 + 4 fragments	St. Mary's College, Contra Costa County, California
<i>F. lanceolata</i>	n = 24	San Mateo County, California
<i>F. lanceolata</i>	n = 12 + 1 fragment, 18	Near summit Siskiyou Mountains, Jackson County, Oregon
<i>F. lanceolata</i>	n = 12	West of Harts Pass, Whatcom County, Washington
<i>F. liliacea</i>	n = 12	Richmond, Contra Costa County, California
<i>F. phaeanthera</i>	n = 18	Butte County, California
<i>F. pluriflora</i>	n = 12	Near Nord, Butte County, California
<i>F. pudica</i>	n = 12	Pullman, Whitman County, Washington
<i>F. pudica</i>	n = 12	Snake River Canyon, Whitman County, Washington
<i>F. pudica</i>	n = 12 + 1 fragment	Ownbey (personal communication)
<i>F. pudica</i>	n = 12, 13, 39/2	Tischler (20)
<i>F. Purdyi</i>	n = 12	Cobb Valley, Lake County, California
<i>F. recurva</i>	n = 12	North of Lake Tahoe, Placer County, California
<i>F. recurva</i>	n = 12	Near Grants Pass, Josephine County, Oregon
<i>F. recurva</i>	n = 12 + 1 fragment	Tischler (20)
<i>F. recurva</i>		North side of Mount St. Helena, Sonoma County, California
var. <i>coccinea</i>	n = 12	Cobb Valley, Lake County, California
<i>F. recurva</i>		
var. <i>coccinea</i>	n = 12	

in shape, regardless of flower size. Lack of distinctive characters, other than a simple increase in size, suggests the occurrence of polyploidy in this group.

Chromosome counts from two lots of Washington plants show them to be diploid, $n = 12$. A collection of *F. pudica* from the Warner Mountains, Modoc County, California, is reported by Marion Ownbey (personal communication) to be diploid with one fragment. Tischler (19) records counts of $n = 12$, 13, and 39/2 for this species and Darlington (5, p. 248) reports $n = 13$, a number which he believes to be derived by fragmentation.

As in the case of *F. lanceolata*, random measurements of stamata and pollen grains of *F. pudica* showed no hiatus separating diploids from suspected polyploids. Similarly, there was no geographic separation; large and small plants occurred together throughout the same area. Except for differences in size, evi-

dence points to a widespread and morphologically rather uniform species in which polyploids have developed and have been perpetuated asexually. These have remained in or near the original colony.

Fritillaria phaeantha Eastwood occurs in Butte and Plumas counties, California, with *F. parviflora* and *F. recurva*. Study of herbarium specimens of *F. phaeantha* showed a complete flower series from pale, greenish, unmottled flowers with recurved perianth segments to red bells resembling small flowers of *F. recurva*. Furthermore, a high degree of sterility was evident; at least one and often all flowers on a plant having undeveloped pistils four millimeters long. The pollen was estimated as only seventy per cent fertile. Triploid chromosome counts, $x = 18$, were obtained from three collections of *F. phaeantha* from Butte County. While it is not yet proven that *F. phaeantha* is a partially sterile hybrid between *F. parviflora* and *F. recurva*, it is evident, in some localities common to both, that they do cross.

TAXONOMY

The genus *Fritillaria* was erected by Linnaeus (14) to accommodate Tournefort's Persian species *Corona Imperialis* and two others, *Fritillaria persica* and *F. regia*. Subsequently, the genus was split into sixteen other genera. Also, some of the species now belonging to it were first described under such well established genera as *Lilium* and *Tulipa*.

In North America, the first species of *Fritillaria* known was *F. camschatcensis*, described by Linnaeus (14) as a *Lilium* native to Kamschatka and Canada. Not until early in the Nineteenth Century when the west was visited by such explorers and collectors as Lewis, Nuttall, Douglas, Frémont and Hartweg were other species discovered. Since this time, as a result of state surveys of California, private explorations and greater settlement of the west, some two dozen names of species and many varieties have been added.

One of the earliest monographs useful in identifying the species of *Fritillaria* was published by Schultes (17) who lists from America *F. lanceolata* and three other species later transferred to *Calochortus*. *Fritillaria pudica* and *F. camschatcensis* as well as two other entities which are now considered synonyms of the latter, were included in *Lilium*.

The genus was treated again by Kunth (13). He accepts seven American species, but merely quotes original descriptions, making no attempt to reduce any of the names to synonymy, nor to ease the task of the botanist seeking to identify species.

Baker's (2) revision of the Tulipeae divides *Fritillaria* into ten subgenera, four of them containing the ten American, as well as some European, species. His divisions were based on bulb and style characters and upon the size and shape of the nectaries. In

spite of having inadequate material and placing too much reliance upon the characters of the nectary, which are variable and extremely difficult to determine in dried material, the revision is well done.

Watson (22), in his revision of the North American Liliaceae, divides nine species of *Fritillaria* into three sections, the separation being made on the nature of the style, capsule and bulb. Watson's treatment is considerably better than Baker's, but in accepting some of the characters that Baker attributed to some species, he placed obviously unrelated species in the same section.

Bentham and Hooker (3) and Engler and Prantl (6) treat *Fritillaria* identically. They recognize five sections, two of them containing all the American as well as some European species.

Recent floras, particularly those including California, list a dozen or more species of *Fritillaria*. Jepson (12) recognizes thirteen species and six varieties in California. Abrams (1) recognizes fifteen species in the three Pacific states.

The arrangement followed in the present monograph corresponds closely with that proposed by Watson, although the position of some species is shifted and the divisions are not accorded the rank of sections. Seventeen species and two varieties, included in one section, are recognized for North America.

In preparing this monograph, in addition to field observation and collections of the writer, material from the following herbaria was examined: California Academy of Sciences; Clokey Herbarium at the University of California, Berkeley; Dudley Herbarium, Stanford University; Field Museum of Natural History; Willis L. Jepson Herbarium, University of California, Berkeley; Missouri Botanical Garden; New York Botanical Garden; Pomona College; Rocky Mountain Herbarium; University of California, Berkeley; University of California, Davis; State College of Washington; Willamette University. Specimens cited are chiefly those widely distributed among the above herbaria.

The writer takes this opportunity to express gratitude to the many friends and teachers who have generously given assistance: to Dr. Herbert L. Mason under whose direction the investigation was carried on, and to Dr. G. L. Stebbins, Jr., for guidance in the cytological part of the undertaking and assistance in collecting and establishing plants at Berkeley; to Dr. Marion Ownbey and Mr. Milo S. Baker who sent bulbs and cytological material; and to many other friends and collectors who have sent either living material or herbarium specimens; to the curators of the herbaria who made available material for study; to Dr. Alan A. Beetle for suggesting the subject and for assisting the work to completion; to Dr. John L. Morrison for providing the illustration of *F. folcata*.

FRITILLARIA L. Sp. Pl. ed. 1: 303. 1753.

Perennial; bulb of one or more thick, fleshy scales, with or without rice-grain bulblets; basal leaf solitary, ovate or elliptic,

borne in the years before the stem (flowering stalk) appears; stem erect, glabrous, simple; cauline leaves whorled or alternate, lanceolate or linear, sessile; flowers in racemes or solitary and terminal; perianth campanulate or tubiform, deciduous, of six distinct segments in two whorls; segments usually bearing a shallow



FIG. 1. *Fritillaria folcata*. Habit, $\times 1$; flower, $\times 1\frac{1}{2}$.

gland or nectar-bearing area above the base; stamens six, included, inserted on base of the perianth segments, their filaments slender, anthers extrorse, more or less versatile; ovary sessile or

nearly so, style one, entire or trifid; capsule membranaceous, six-angled or winged, three-valved, loculicidally dehiscent; seeds numerous, in two rows in each cell. (Latin *fritillus*, a dice box, named for the shape of the capsule.)

Type species: *Fritillaria Imperialis* L.

Section *Liliorhiza* (Kellogg) Baker, Jour. Linn. Soc. Bot. 14: 211-310. 1874.

Bulbs of several fleshy scales or with rice-grain bulblets, without a tunic and not squamose; flowers racemose or solitary.

KEY TO THE SPECIES

Throughout the key and descriptions, the stem measurement is made from its attachment at the bulb to the top of the inflorescence.

- I. Style entire or shortly three-lobed; perianth not mottled; glands obscure.
 - A. Stem with leaves only on lower half, alternate; bulb of several thick scales.
 1. Flowers yellow; stem 7-35 cm. long ... 1. *F. pudica*
 2. Flowers pink to lavender.
 - a. Perianth segments not recurved; style triparted at apex; stem 20-45 cm. long 2. *F. pluriflora*
 - b. Perianth segments recurved; flowers pink, mauve, or whitish with red stripes; stem 25-38 cm. long 3. *F. striata*
 - B. Stem leafy above, lower third or half naked; leaves whorled; rice-grain bulblets present; flowers pinkish-purple 4. *F. Brandegei*
- II. Style trifid; stigmas linear; glands mostly obvious.
 - A. Stem with leaves on lower half, alternate; bulbs of several scales.
 1. Flowers not mottled.
 - a. Flowers white 5. *F. liliacea*
 - b. Flowers colored.
 - 1) Flowers greenish-yellow.
Stem 30-59 cm. long; odor obnoxious; Great Valley of California 6. *F. agrestis*
 - Stem 12-18 cm. long; flowers purplish, greenish-yellow; confined to serpentine 7. *F. glauca*
 - 2) Flowers brown or greenish-purple; stem 15-45 cm. long 8. *F. biflora*
 2. Flowers mottled.
 - a. Leaves thin; flowers checkered purple and white, shaded with pink; stem 10-35 cm. long 9. *F. Purdyi*
 - b. Leaves succulent; flowers checkered rust and white; stem 12-20 cm. long 10. *F. folcata*
 - B. Stem leafy above, the lower third or half naked; leaves mostly whorled; bulbs usually with rice-grain bulblets.
 1. Perianth not mottled or scarcely so.
 - a. Capsule obtusely angled; flowers

- dark green bronze to purple,
extremely small, numerous rice-
grain bulblets
11. *F. camschatcensis*
- b. Capsule winged.
- 1) Flowers purplish to green-
ish-white, occasionally mot-
tled; 12–20 mm. long
12. *F. parviflora*
- 2) Flowers greenish to reddish-
yellow; segments recurved;
faintly mottled, 10–15 mm.
long
13. *F. phaeanthera*
2. Perianth mottled.
- a. Flowers tubiform, checkered red
and yellow; style cleft one-
fifth to one-fourth its
length.
- 1) Perianth segments recurved;
rice-grain bulblets present
14. *F. recurva*
- 2) Perianth segments usually
not recurved; bulb of few
scales
- 14a. *F. recurva*
var. *coccinea*
- b. Flowers campanulate.
- 1) Flowers red, checkered
purple; style cleft one-half
its length or more; leaves
alternate
15. *F. adamantina*
- 2) Flowers not red.
- a) Leaves ovate-lanceo-
late; flowers mottled
brownish-purple on
greenish-yellow, 20–
40 mm. long
16. *F. lanceolata*
- b) Leaves linear in indefi-
nite whorls; flowers
spotted brown, yel-
low and white, 9–
21 mm. long.
Bulb with rice-grain
bulblets; stem
slender
17. *F. atropurpurea*
- Bulb of several
scales; stem usually
stout
- 17a. *F. atropurpurea*
var. *pinetorum*

1. FRITILLARIA PUDICA (Pursh) Spreng. Syst. 2: 64. 1825.
Lilium ? *pudicum* Pursh, Fl. Am. Sept. 1: 228. 1814. *Amblirion*
pudicum Raf. Jour. Physics 89: 102. 1819. *Theresia pudica* Klatt,
Hamb. Gart. 16: 439. 1860. *Fritillaria leucella* Gand. Bull. Soc.
Bot. France 66: 291. 1920. *F. dichroa* Gand. *ibid.* *F. washing-*
tonensis Gand. *ibid.* *F. utahensis* Gand. *ibid.* *F. oregonensis* Gand.
ibid. *F. oreodoxa* Gand. *ibid.*

Colored illustration. Curtis Bot. Mag. 163: tab. 9617. 1942.

Bulb of small, thick scales; stem 7.5–35 cm. long; leaves alter-
nate, few, scattered, linear to lanceolate, 6.25–20 cm. long, 2–11
mm. wide; flowers 1 to 3, yellow to orange, sometimes brown-
veined outside, turning brick red with age; perianth segments

15–19 mm. long, 4–7 mm. wide; gland at base of each segment small; style thick, approximately the length of the perianth segments, stigma knobbed at apex; stamens half the length of perianth segments; capsule obovoid-oblong, 17 mm. long; flowering from March to July, according to elevation. In the few known tetraploids, the above measurements may be doubled.

Distribution. Western United States and British Columbia, also reported from Alberta.

Type. "Plains of Columbia near the Kooskooskee" [Clearwater River, Idaho], 1806, *Lewis*.

Representative material. BRITISH COLUMBIA. Yale County: Lake Okanogan, *Spreadborough 61279*; Grand Forks, Yale and Caribou, *Anderson 321*; Kamloops, *McCabe 1973*. WASHINGTON. Chelan County: Chiwaukum, *St. John 9447*. Kittitas County: Table Mt., *Hitchcock et al. 3628*. Yakima County: Fort Simcoe, *Burgner 3*. Klickitat County: Bingen, *Suksdorf 5917* (type collection of *F. oredoza*). Okanogan County: near Omak, *Fiker 41*. Grant County: East White Bluffs, *St. John 3346*. Benton County: 10 mi. west of Hanford, *St. John 8113*. Walla Walla County: Wallula, side canyon above Columbia River, *St. John et al. 3128*. Ferry County: 4 mi. above mouth of East Kettle River, *Rogers et al. 269*. Lincoln County: south side of Spokane River at mouth, *Rogers et al. 258*. Stevens County: 7 mi. south of Kettle Falls, *Spiegelberg 96*. Columbia County: Tallow Flat, *Darlington 27*. Pend Oreille County: Newport, *Sprague 109*. Spokane County: Spokane, *Milburge 236*. Whitman County: north of Pullman, *Pickett 1070*. Garfield County: 10 mi. south of Pomeroy, 1921, *Courtney*. Asotin County: Rogersberg, *Ransom & Ridout 91*. OREGON. Jackson County: Table Rock, *Henderson 5791*. Wasco County: Mosier, 1893, *Howell*. Klamath County: McCullom's Mill, Klamath River, *Henderson 9355*. Sherman County: John Day Valley, *Henderson 5116*. Umatilla County: 6 mi. east of Umatilla, *Moore 120*. Grant County: Blue Mts., *Henderson 5116*. County unknown: east Oregon, dry hills, *Cusick 1831* (type collection of *F. oregonensis*). CALIFORNIA. Siskiyou County: near Yreka, *Butler 1089*. Trinity County: mountains, 1916, *Ruddock*. Shasta County: Fall River Mills, 1923, *Betticel*. Modoc County: Cedar Peak, near Cedar Pass, *Ownbey & Meyer 2141*. Plumas County: Greenville, 1920, *Clemens*. Sierra County: Sierra Valley, 1872–1877, *Lemmon*. MONTANA. Missoula County: Missoula, *Kirkwood 1052*. Lewis and Clark County: Helena, 1893, *Starz*. Cascade County: Belt Creek, 1894, *Anderson*. Gallatin County: Bozeman, 1893, *Gottschatch*. Carbon County: 4 mi. northwest of Red Lodge, 1905, *Draper*. Yellowstone County: Custer, 1890, *Blankinship*. WYOMING. Yellowstone Park, Mammoth Hot Springs, 1889, *Dewart*. Teton County: Burned Ridge, *Williams 1097*. County uncertain: Hayden National Forest, *Nelson 11356*. IDAHO. Kootenai County: Hauser, *Applegate 6701*. Latah County:

Moscow, *Abrams* 538. Nez Perce County: north side of Snake River opposite Clarkston, *Constance & Rollins* 995. Lemhi County: Salmon, Mt. Baldy, *Payson & Payson* 1852. Bannock County: Oxford, 1885, *Leonard*. UTAH. Box Elder County: Wellsville Mts., Cold Water Canyon, *Burke* 2907. Cache County: Providence Bench near mouth of Providence Canyon, *Maguire* 3257. Salt Lake County: Garfield, 1915, *Jones*. Utah County: Mercur, 1896, *Jones*. NEVADA. Washoe County: Verdi, 1895, *Hillman*.

2. *FRITILLARIA PLURIFLORA* Torrey in Benth. Pl. Hartweg. 338. 1857.

Bulb yellowish, of several scales, 1.25 cm. or more long, stem 20–45 cm. long; leaves clustered on lower part of stem, alternate, elliptical to obovate-oblong, 6.25–12.5 cm. long, 7–15 mm. wide; flowers 1 to 3, rarely 7; perianth segments obovate, 25–35 mm. long, 7–15 mm. wide, pinkish-purple; style triparted at apex; gland continuing as a depressed green vein through center of perianth segment; capsule essentially quadrate, lobes with two dorsal ridges raised so as to suggest wings; flowering from February to April.

Distribution. California and Oregon, in adobe soil of the interior foothills at 175 to 1500 feet elevation.

Type. "California, in valle Sacramento," *Hartweg* 258; [Feather River], *Frémont* 313.

Representative material. CALIFORNIA. Mendocino County: Ukiah, 1898, *Purdy*. Glenn County: Elk Creek, *Duran* 3376. Yolo County: hills west of Winters, 1932, *Smith*. Solano County: Swarney Creek, 1898, *Platt*. Butte County: near Clear Creek, *Brown* 141. OREGON. Lake County: Fremont National Forest, near summit of Crane Creek Mt., *Ferris & Duthie* 247.

3. *FRITILLARIA STRIATA* Eastwood, Proc. Calif. Acad. Sci. ser. 4, 20: 136. 1931.

Bulb with thick scales; stem 25–37.5 cm. long; leaves on lower half of stem, alternate, slightly glaucous, 6.25–6.87 cm. long, 10–15 mm. wide, ovate-oblong; flowers 2 to 3, occasionally 7, nodding, white, mauve or pink, often with red stripes, fragrant; perianth segments 26–35 mm. long, 7–10 mm. wide, usually recurved; gland obscure, continued as a vein through center of perianth segment; style barely triparted at apex; pistil 15 mm. long, equal to or shorter than the stamens; capsule essentially quadrate, 21 mm. long, unwinged; flowering in March and April.

Distribution. California, in adobe soil of the interior foothills of the San Joaquin Valley at 2500 feet elevation.

Type. Greenhorn Mts., Rattlesnake Grade, 1927, *E. R. Weston* 524.

Representative material. CALIFORNIA. Tulare County: Lindsey, 1928, *Harter*; Strathmore, Fraser Valley, 1927, *Kelly*; Porter-

ville, 1922, *Cantwell*. Kern County: between Kern River and Little Poso Creek, Greenhorn Mts., 1933, *Weston*.

4. *FRITILLARIA BRANDEGEI* Eastwood, Bull. Torrey Bot. Club 30: 484. 1903. *F. Hutchinsonii* Davidson, Bull. So. Calif. Acad. Sci. 27: 79. 1928.

Bulb with rice-grain bulblets; stem 40–100 cm. long; leaves in several whorls on upper half of stem, usually 5 in a whorl, 5–10 cm. long, 4–20 mm. wide; flowers nodding, 4 to 12, pinkish or purplish; perianth segments 12–17 mm. long, 2–3 mm. wide, spreading and becoming involute with age; gland small, rather triangular; stigma slightly cleft at apex; pistil nearly as long as the perianth segments; stamens shorter than pistil; capsule winged; flowering in April.

Distribution. California, in the yellow pine belt at 5000–7000 feet elevation. The species occurs in the southern Sierra Nevada where there is a gap in the distribution of digger pine (*Pinus Sabiniana*). Granites, rather than the usual ferro-magnesium rocks of the digger pine belt of this altitude underlie the soil. Hence the distribution may be linked with edaphic conditions.

Type. Coburn's Mills, Tulare County, 1890, *T. S. Brandegee*.

Representative material. CALIFORNIA. Tulare County: North Bear Creek, *Purpus* 1747. Kern County: Greenhorn Mts., Rattlesnake Road from Bakersfield to Kernville, a short distance below Shirley Meadows, 1927, *Weston*; Greenhorn Mts., below Cedar Creek Public Camp, 1940, *Dearing*.

5. *FRITILLARIA LILIACEA* Lindl. Bot. Reg. t. 1663. 1835. *Liliorhiza lanceolata* Kellogg, Proc. Calif. Acad. Sci. 2: 46. 1863.

Bulb of round scales; stem 12.5–36.5 cm. long; leaves borne near the base, alternate, ovate to linear, 5–10 cm. long, 4–15 mm. wide; flowers 1 to 3, white with green striations; perianth segments 10–16 mm. long, 5–6 mm. wide, tip of each segment beaked and bearing a tuft of white hairs; gland green, spotted with minute purple dots, continuing as a glandular vein; style cleft half its length; pistil half as long as the perianth segments; stamens shorter than pistil; capsule 15 mm. long, stipitate, the back of each lobe slightly channeled and two-ridged; flowering from February to April.

Distribution. California, from Sonoma County to Monterey County on open hills and fields near the coast.

Type. "California," *Douglas*.

Representative material. CALIFORNIA. Sonoma County: Bennett Peak, 1897, *Baker*. Marin County: ridge east of Garcia, 1929, *Galoway*. Contra Costa County: Richmond, near San Pablo Avenue, *Beetle* 14. Alameda County: Oakland, near Lake Chabot, *Walker* 2909. San Francisco County: San Francisco, Potrero

Hills, 1895, *Cannon*. San Mateo County: Redwood City, *Rose* 33049. San Benito County: Aromas, Hickman Ranch, 1915, *Eastwood*. Monterey County: Pfeifer's Point, 1917, *Parsons*.

6. *FRITILLARIA AGRESTIS* Greene, *Erythea* 3: 67. 1895.

Bulb deep-seated, with stout scales; stem 30–50 cm. long; leaves on lower part of stem, alternate, crowded, oblong-oblongeolate to linear-lanceolate, 7.5–11.25 cm. long, 12–17 mm. wide;

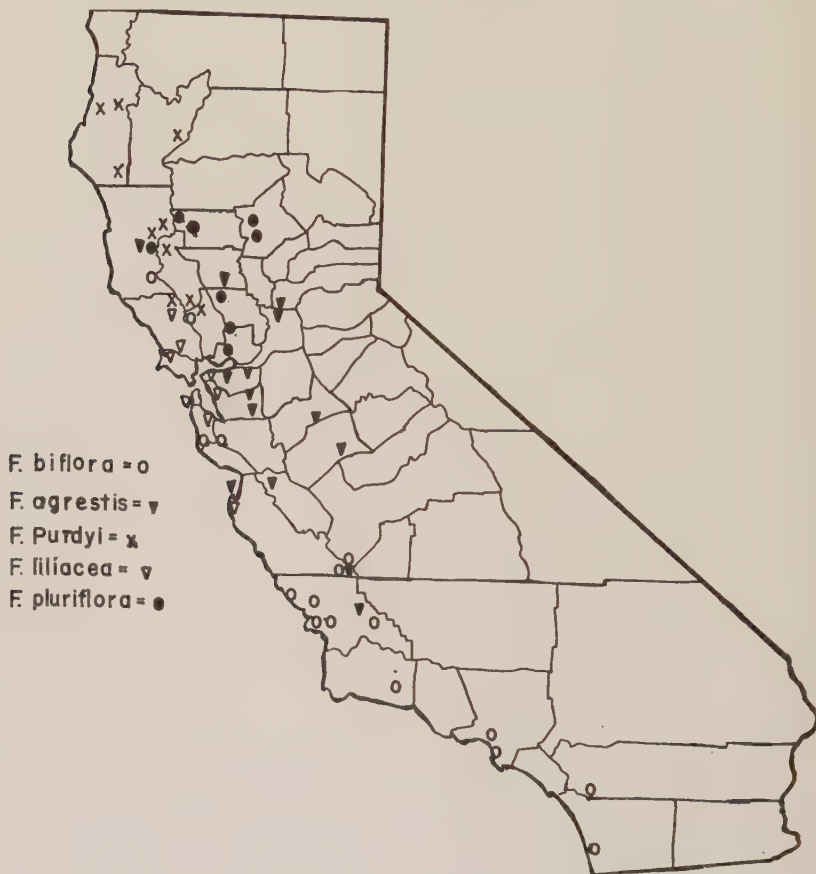


FIG. 2. Distribution of certain species of *Fritillaria* in California.

flowers 1 to 8, on stout recurved pedicels, greenish-yellow with green veins, odor obnoxious; perianth segments beaked, 24–30 mm. long, 7–10 mm. wide; gland green, continuing as a central stripe; style cleft half its length; pistil two-thirds the length of the perianth segments; stamens half as long as perianth seg-

ments; capsule 17 mm. long, essentially quadrate; flowering from March to April.

Distribution. California, at low elevations in the fields and hills of the Great Valley.

Type. California, "Antioch," *Greene*.

Representative material. CALIFORNIA. Mendocino County: Ukiah, 1938, *Purdy*. Colusa County: Arbuckle, *Winter* 751. Placer County: Roseville, 1894, *Congdon*. Sacramento County: 1903, *Durham*. Contra Costa County: Antioch, *Davy* 987. Alameda County: Tesla hills, *Howell* 12590. San Mateo County: New Year Point, Año Nuevo, *Ferris* 2120. Stanislaus County: Turlock, 1921, *Wickes*. Merced County: Planada, near Merced, 1922, *Ebright*. Fresno County: near Trimmer, 1943, *Carter* 42. San Benito County: San Juan, 1921, *Van Denburgh*. Monterey County: near Parkfield, *Eastwood & Howell* 4218. San Luis Obispo County: west side of Cottonwood Pass, *Eastwood & Howell* 2047.

7. FRITILLARIA GLAUCA *Greene*, *Erythea* 1: 153. 1893.

Bulb of few fleshy scales; stem 12.5–17.5 cm. long; leaves 2 to 4, glaucous, alternate, confined to lower half of stem, 3.75–8.75 cm. long, 5–14 mm. wide, ovate; flowers 1 to 2, nodding, purplish or greenish marked with yellow, the colors varying; perianth segments 17–27 mm. long, 6–9 mm. wide, lanceolate; gland not obvious, appearing as a small midvein; style parted half its length; pistil nearly as long as the perianth segment; capsule quadrate, 21 mm. long; flowering from April to July.

Distribution. Northwestern California and southwestern Oregon on hilly serpentine areas, 2000–7000 feet in elevation.

Type. "Oregon, near Waldo," *Howell* 928.

Representative material. OREGON. Douglas County: 1 mi. northwest of Abbots Butte, watershed of South Fork of Umpqua River, 1899, *Leiberg*. Josephine County: top of Tennessee Pass, 4 mi. from Kerby, *Henderson* 5792. CALIFORNIA. Del Norte County: Telephone Point, *Eastwood* 146. Humboldt County: Grouse Mt., *Purdy*. Trinity County: Devils Canyon Mts. at head of Whites Creek, *Tracy* 14565. Glenn County: west of road up Black Butte, *Baker* 10047. Lake County: Hull Mt., *Purdy*.

8. FRITILLARIA BIFLORA *Lindl. Bot. Reg.* 20: t. 1663. 1835. *F. kamschatcensis* *Torr. Pac. Railroad Rep.* 4: 146. 1857. *F. Grayana* *Reichb. f. and Baker, Jour. Bot.* 16: 263. 1878. *F. biflora* var. *agrestis* *Greene, Manual Botany Bay Region* 311. 1894. *F. succulenta* *Elmer, Bot. Gaz.* 41: 311. 1906. *F. biflora* var. *Ineziana* *Jepson, Fl. Calif.* 1: 306. 1921. *F. biflora* var. *inflexa* *Jepson, ibid.* 1921.

Bulb of fleshy scales; stem 15–45 cm. long; leaves scattered or appearing somewhat whorled at the base, oblong to ovate-

lanceolate, 5–10 cm. long, 6–40 mm. wide; flowers nodding, 1 to 7, dark brown or greenish-purple; perianth segments 21–35 mm. long, 5–12 mm. wide; gland appearing as a longitudinal green band extending nearly to apex of perianth segment; style divided one-half to two-thirds its length; pistil and stamens approximately the same length, half the length of the perianth segments; capsule 12–25 mm. long, not winged; flowering from February to June.

Distribution. Southern California in cismontane regions at low altitudes; also localized in Mendocino County, and reported from Mexico (Sesse and Mocino, 1887, "in montibus Sancti Angeli").

Type. "Nova California," 1833, *Douglas*.

Representative material. CALIFORNIA. Mendocino County: Ukiah, *Bolander 4654* (type collection of *F. Grayana*). Napa County: Calistoga, in Napa Range, 1916, *Lutzi*. San Mateo County: Hillsboro, 1914, *Smith* (type of var. *Ineziana*). Santa Clara County: near San Jose, 1877, *Lemmon*. Monterey County: 1886, *Plaskett*. Fresno County: Coalinga to Parkfield, *Peirson 5647*. San Luis Obispo County: San Simeon Bay, 1934, *Snu-sheimer*. Santa Barbara County: road to Mt. Figueroa, *Schreiber 1626*. Los Angeles County: San Dimas, 1897, *Chandler*. Riverside County: Winchester, *Hall 384*. San Diego County: Point Loma, 1895, *Brandegge*.

9. *Fritillaria purdyi* Eastwood, Bull. Torrey Bot. Club 29: 75. 1902.

Bulb of fleshy scales; stem 10–35 cm. long; leaves ovate, alternate, crowded at the base, 2.5–6.25 cm. long, 6–16 mm. wide; flowers 1 to 7, checkered purple and white with pink shadings, revolute towards the apex which bears a tuft of whitish hairs; perianth segments 20–22 mm. long, 7–9 mm. wide; gland not obvious, a nectariferous area at base of perianth segment; style cleft half its length; pistil 15 mm. long; anthers lavender-pink, becoming yellow; capsule about as broad as high, not winged; flowering from March to June.

Distribution. California, in the inner Coast Ranges on serpentine ridges at 2500–6900 feet elevation.

Type. Humboldt County, California. "Kneeland, cultivated at Purdy Gardens from material sent by Lowe," 1901, *Purdy*.

Representative material. CALIFORNIA. Humboldt County: Chalk Mt., 1923, *Barnwell*. Trinity County: Lewiston, 1915, *Philips*. Mendocino County: Buck Rock Ridge, *Eastwood 15297*. Lake County: Cobb Valley, near Cobb, *Beetle 26*. Sonoma County: Mt. St. Helena, *Eastwood 4660*. Napa County: Palisades, Mayacama Range, north of Calistoga, *Applegate 7038*.

10. *Fritillaria folcata* (Jepson) comb. nov. *F. atropurpurea* var. *folcata* Jepson, Fl. Calif. 1: 309. 1921.

Bulb of several fleshy scales; stem slender, 12.5–20 cm. long; leaves 2 to 6, alternate, scattered, succulent and somewhat folded, 3.75–8.75 cm. long, 7–15 mm. wide; flowers 1 to 4, erect, campanulate, greenish without, mottled rusty brown and yellow within; perianth segments obovate, 15–22 mm. long, 5–7 mm. wide, tuft of hairs at apex pinkish; gland yellow, spotted brown, extending from the base a third the length of the perianth segment; style tripartite; pistil 14 mm. long, longer than the stamens; anthers rust colored before anthesis, turning yellow; capsule 20 mm. long, nearly as broad, acutely angled with horn-like processes at summit and base of angle; flowering from March to May.

Distribution. California, in the inner South Coast Ranges on serpentine talus at 1000–3000 feet elevation.

Type. "San Benito Co., San Benito Peak," *Jepson 2715*.

Representative material. CALIFORNIA. Stanislaus County: Adobe Creek, Red Mts., Mt. Hamilton Range, *Sharsmith 1671, 3579*. Santa Clara County: Colorado Creek, Red Mts., Mt. Hamilton Range, *Beetle 17, Carter 1047*.

The vegetative habit of this species is similar to that of *F. glauca*; the flower more nearly resembles that of *F. Purdyi*. All three species are restricted to serpentine soil.

11. FRITILLARIA CAMSCHATCENSIS (L.) Ker-Gawl. Curtis Bot. Mag. 30: t. 1216. 1809. *Lilium camtschatcense* L. Sp. Pl. 1: 303. 1753. *L. quadrifoliatum* Meyer, Reliq. Haenk. 2: 126. 1825. *L. affine* Schult. Syst. Veg. 7: 400. 1829. in part. *Amblyrium camtschacense* Sweet, Hort. Brit. 2: 538. 1830.

Bulb with many extremely small bulblets; stem 17.5–65 cm. long, stocky; leaves usually in 3 whorls, 5 to 11 leaves in a whorl, lanceolate, 5–7.5 cm. long, 7–20 mm. wide; flowers 1 to 8, dark green-bronze to purple-brown, rarely spotted with yellow; perianth segments cressulated towards the apex, usually having lamellae on the inner surfaces and bearing a few pinkish hairs at the apex, 25–27 mm. long, 7–9 mm. wide; gland waxy purple, near base of segment; style cleft one-half to two-thirds its length; pistil 15–18 mm. long; stamens 12–14 mm. long; capsule 18–38 mm. long, 14–24 mm. wide, not winged; flowering in June.

Distribution. Alaska to Washington and west into Kamtchatka and Japan, occurring near the coast. Hultén (10, pp. 38–48) lists this species as one of the group of plants (south Berengia radiants) which after the Pleistocene glaciations reoccupied their original area of the Bering Sea, Japan, Kamtchatka, and the coast of Alaska and Canada, but which also spread farther south than before in both America and Asia.

Type locality. "Canada and Kamtchatka."

Representative material. ALASKA. Unalaska Is., 1920, *Stewart*. Popof Is., Shumagin Islands, *Trelease et al. 3231*. Kodiak Is.,

Alitak Bay, 1924, *Miner*. Dolonu, 1913, *Beach*. Afoguak, 1917, *Noyes*. Excursion Inlet, 1926, *Haley*. Shores of Yes Bay, *Howell* 1663. Wingham Is., 1927, *McMillin*. Branoff Is., Kelp Bay, *Walker & Walker* 799. Prince of Wales Is., Kasaan Bay, *Newcombe* 120. Beardslee Is., Glacier Bay, *Anderson* 1199. Khantaak Is., *Funston* 38. Hinchinbrook Is., 1937, *Norberg*. BRITISH COLUMBIA. Banks Is., Colby Bay, *McCabe* 7325. Islets off Moore Islands, north west of Aristazabal Is., *McCabe* 3430. Khutze Inlet, Graham Reach, *McCabe* 3483. Spider Is., *McCabe* 4338. Calvert Is., *McCabe* 4368. Bella Coola, Whiskey Bay, *McCabe* 1589. Queen Charlotte Sound, Ann Is., *McCabe* 1795. Pender Harbor, Garden Bay, *McCabe* 1622. Vancouver Is., Nanaimo, 1887, *Macoun*. Indianpoint Lake, 25 mi. northeast of Barkerville, *McCabe* 98A. WASHINGTON. Whidby Is., *Gardner* 281. Snohomish County: Silverton, *Bouck* 188.

12. FRITILLARIA PARVIFLORA Torr. Pac. Railroad Rept. 4: 146. 1857. Not *F. parviflora* Mart. Hort. Monacensis. 1838. *F. multiflora* Kellogg, Proc. Calif. Acad. 1: 57. 1855, *nomen provisorium*. *F. micrantha* Heller, *Muhlenbergia* 6: 83. 1910.

Bulb of a few scales with numerous rice-grain bulblets; stem 47.5–90 cm. long; leaves on upper half of stem, whorled, 4 to 6 in a whorl, linear to linear-lanceolate, 5–15 cm. long, 3–10 mm. wide; flowers nodding, 4 to 10, purplish or greenish-white, occasionally faintly mottled; perianth segments 12–20 mm. long, 4–5 mm. wide, bearing a tuft of white hairs on the apex; gland oblong-lanceolate, on lower third of segment; style trileft one-third to two-thirds its length; pistil 12–13 mm. long; capsule broadly winged, slightly wider than long; flowering from April to June.

Distribution. California in the pine woods of the Sierra Nevada at 1500–6000 feet elevation.

Type. "Calaveras Co., hillsides near Murphy's," *Bigelow*.

Representative material. CALIFORNIA. Plumas County: Greenville, 1921, *Kelley*. Butte County: Forbestown road out of Oroville, 1938, *Purdy*. Sierra County: near Yuba Pass, *Bacigalupi* 1597. Yuba County: Penn Valley, *Jepson* 14826. Nevada County: near Nevada City, 1913, *Coombs*. Placer County: Auburn, hillside below Bloomer Cut, 1891, *Sonne*. Eldorado County: near Placerville, 1907, *Brandeggee*. Amador County: New York Falls, *Hansen* 51. Calaveras County: Angels Camp, near type locality, *Eastwood* 11620. Tuolumne County: Hetch-Hetchy, *Jepson* 3450. Mariposa County: near Kinsley, 1905, *Hoak*. Fresno County: Sugar Pine, 1929, *McDonald*. Tulare County: Sequoia National Park, 1927, *Bevans*.

The only known copy of Martius' work, listed by B. D. Jackson in his "Guide to the Literature of Botany," is shelved in the Lindley Library and is imperfect. Judging from the title, "Hortus regius monacensis seminifer," it appears evident that the

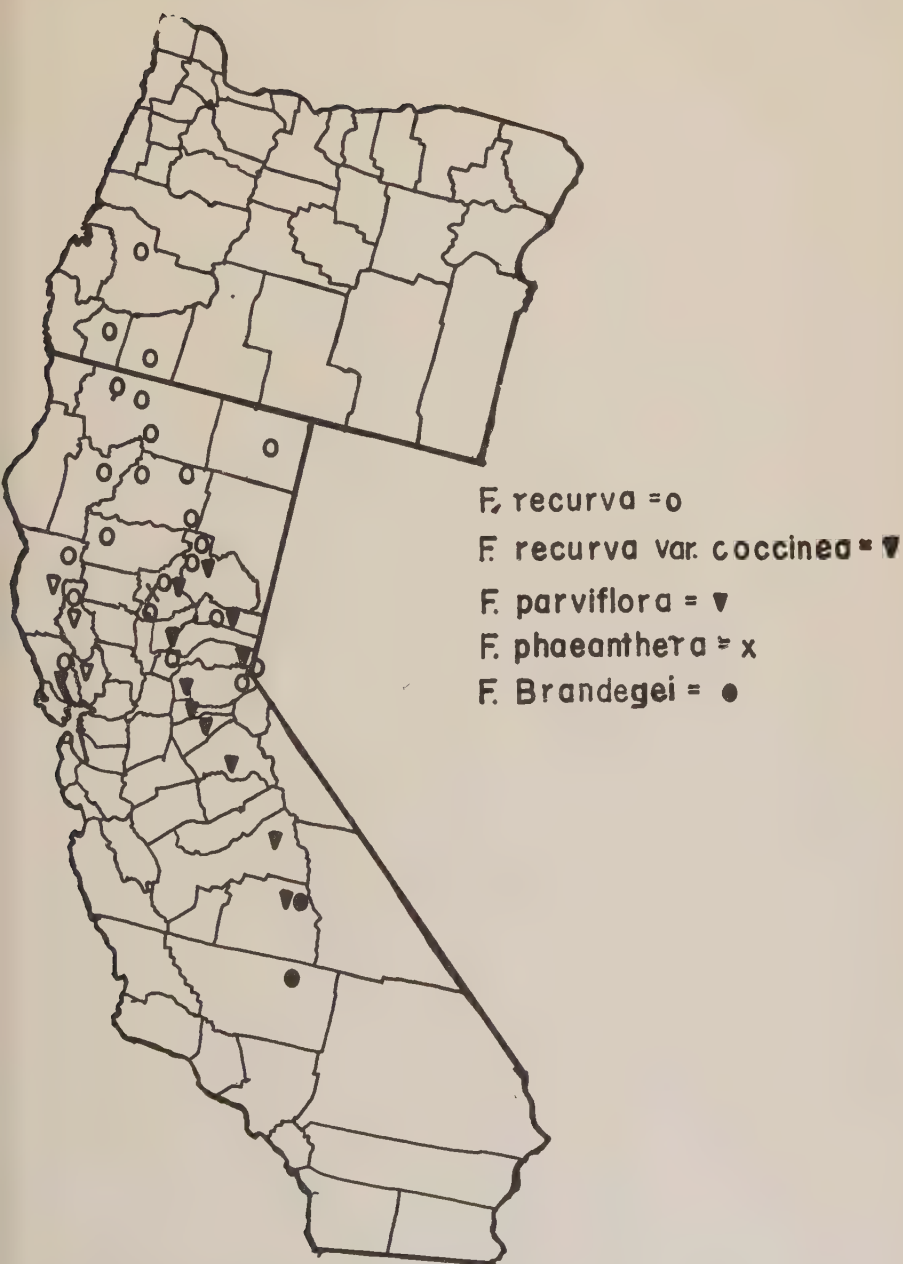


FIG. 3. Distribution of certain species of *Fritillaria* in Oregon and California.

name used by Martius is probably invalidly published, and until such time as this can be definitely established, it seems best to retain *Fritillaria parviflora* Torr. as the name of this entity.

13. FRITILLARIA PHAEANTHERA Eastwood, Leaflets West. Bot. 1: 55. 1933.

Bulb of thick scales surrounded by rice-grain bulblets; stem 30–47.5 cm. long; leaves linear to narrowly lanceolate, 3.75–5.6 cm. long, 5–9 mm. wide, whorled, 3 to 5 in a whorl; flowers nodding, open campanulate, 3 to 7, pale greenish-yellow to a speckled reddish-purple; perianth segments sometimes partially recurved, narrowly ovate, 10–15 mm. long, 2 mm. wide, with a tuft of white hairs at apex; gland indistinct, style cleft half its length, often undeveloped; capsule truncate, winged, seen only in the immature condition; flowering from March to June.

Distribution. California, Butte and Napa counties. Hoover (9, p. 76) in a discussion of the upper Sacramento endemism area, which includes Butte County, gives its annual rainfall as twenty-five inches. This may partly account for the restriction to the area of certain species, among them *F. phaeantha*.

Type. "Butte Co., near Durham," 1932, Mrs. J. H. Morrison.

Representative material. CALIFORNIA. Butte County: Butte Flower Show, 1929 (4 sheets in Calif. Acad. Sci.); near Durham, 1935, Brown; Chico, 1932, Holt; near Cherokee, 1942, Holt; above Paradise, 1942, Purdy (grown at Berkeley). Napa County: Butts Canyon, Crum 1740.

14. FRITILLARIA RECURVA Benth. Pl. Hartweg. 340. 1857.

Bulb of thick scales with many rice-grain bulblets; stem 30–75 cm. long; leaves in 2 to 3 whorls on upper part of stem, 2 to 5 leaves in a whorl, linear to linear-lanceolate, 3.75–10.6 cm. long, 2–14 mm. wide; flowers nodding, tubiform, 1 to 4, scarlet checkered with yellow, becoming purple in age; perianth segments recurved at their tips, 20–38 mm. long, 5–7 mm. wide; gland prominent, oval, depressed, 6 mm. long, yellow with red spots, occupying the lower third of perianth segment; style cleft one-fourth to one-fifth its length; pistil nearly as long as the flower; stamens somewhat shorter; capsule winged, 9–11 mm. long; flowering from March to July.

Distribution. Interior ranges of southern Oregon, California, and western Nevada.

Type. "California, in montibus Sacramento," [Northern Butte County, Sierra Nevada foothills], Hartweg 294.

Representative material. OREGON. Douglas County: rocky hillsides, 1881, Howell. Josephine County: Wimmer, 1893, Hammond. Jackson County: Siskiyou summit, 1934, Eastwood & Howell. CALIFORNIA. Humboldt County: Buck Mt., Tracy 4176. Mendocino County: Long Valley, Bolander 4708. Sonoma County: Hoods Peak, 1902, Baker. Siskiyou County: near Yreka, Butler

1191. Trinity County: Carrville, 1916, *Rose*. Shasta County: between Viola and Manton, *Beetle* 70. Tehama County: coast range near Bennett Spring, *Heller* 13001. Lake County: Elk Mt., *Eastwood & Howell* 5704. Modoc County: in timber, 1893, *Baker*. Plumas County: Greenville, 1920, *Clemens*. Butte County: Feather River near Stirling, *Heller* 13161. Sierra County: Cedar Glen, 1920, *Jones*. Placer County: between Tahoe and Truckee, *Beetle* 46. Nevada County: Nevada City, 1913, *Coombs*. NEVADA. Douglas County: Route 50, 1 mi. south of Glen Brook, *Beetle* 77.

14a. *FRITILLARIA RECURVA* var. *COCCINEA* Greene, *Pittonia* 2: 230. 1892. *F. coccinea* Greene, *ibid.*, p. 250.

Bulb of few scales; stem more slender, usually shorter than in the species, 25–75 cm. long; leaves shorter, linear; flowers usually 1 to 3, tips of segments rarely recurved; flowering from March to June.

Distribution. California, in the inner North Coast Ranges in exposed situations. Where the species and its variety overlap in range, they are often difficult to differentiate.

Type. "California, Sonoma Co., Hoods Peak," 1892, *F. T. Bioletti*.

Representative material. CALIFORNIA. Mendocino County: near Ukiah, 1897, *Purdy*. Sonoma County: Mt. St. Helena, *Beetle* 25. Lake County: Cobb Mt., *Beetle* 27. Napa County: Moore's Creek, 2 mi. southeast of Angwin, 1941, *Hemphill*.

15. *FRITILLARIA ADAMANTINA* Peck, *Proc. Biol. Soc. Wash.* 50: 93. 1937.

Bulb with large scales and rice-grain bulblets; stem stout, 45–60 cm. long; leaves numerous, alternate to roughly whorled, borne on the middle section of the stem, 6.88–11.87 cm. long, 4–6 mm. wide; flowers 6 to 12, campanulate, red spotted with purple; pedicels short and thick; perianth segments 20–25 mm. long, 4–7 mm. wide, oblong-lanceolate; gland obscure; style cleft more than half its length; pistil 11–14 mm. long; immature capsule 15 mm. long, obovate, winged; flowering in July.

Distribution. Oregon, west slope of the central Cascade Mountains.

Type. "Oregon, Douglas Co., east bank of Diamond Lake," *Peck* 19490.

Representative material. OREGON. Douglas County: east bank of Diamond Lake, *Peck* 19733.

This species seems most closely related to *F. recurva*, differing from it in the form and disposition of the perianth segments which are erect rather than recurved, the greater degree to which the style is cleft, and the irregular arrangement of the leaves.

16. *FRITILLARIA LANCEOLATA* Pursh, *Fl. Am. Sept.* 1: 230. 1814. *Amblyrium lanceolata* Sweet, *Hort. Brit. ed.* 1: 427. 1827. *Lilium*

affine Schult. Syst. Veg. 7: 400. 1829, in part. *Fritillaria mutica* Lindl. Bot. Reg. t. 1663. 1835. *F. lanceolata* var. *floribunda* Benth. Pl. Hartweg. 338. 1857. *F. lanceolata* var.? Benth. Pl.

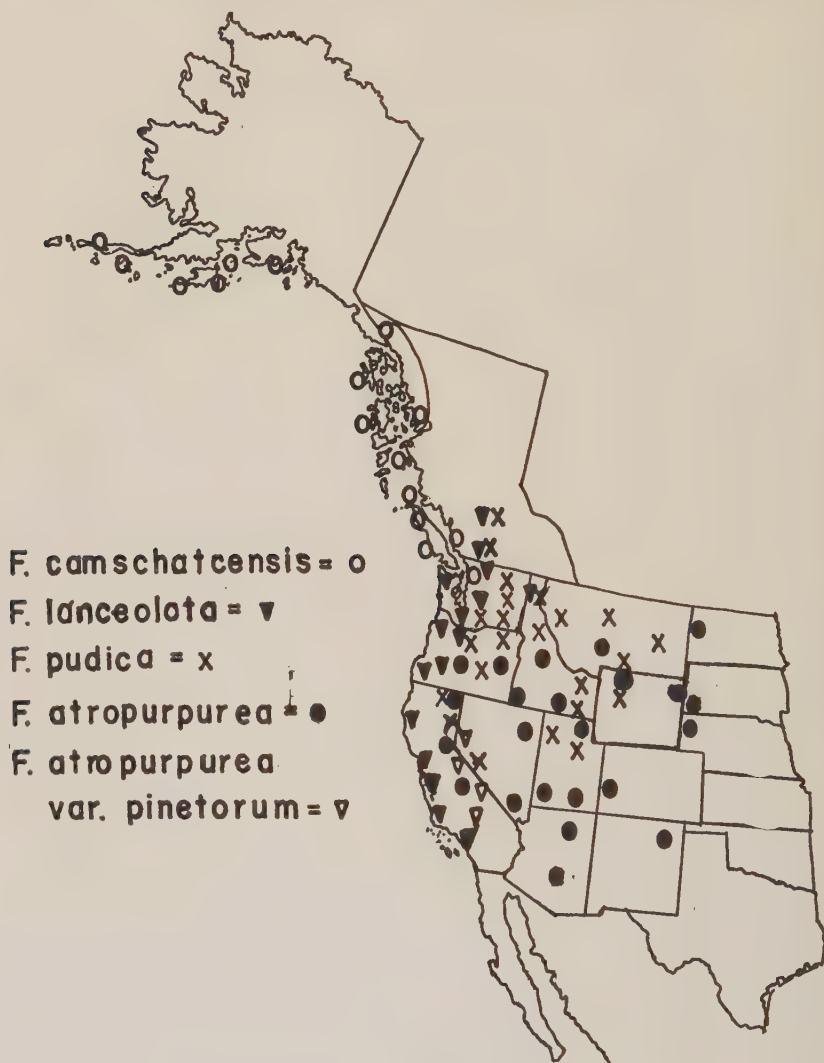


FIG. 4. Distribution of certain species of *Fritillaria* in Western North America.

Hartweg. 340. 1857. *F. viridea* Kellogg, Proc. Calif. Acad. Sci. 2: 9. 1863. *Liliorhiza viridea* Kellogg, Proc. Calif. Acad. Sci. 2: 48. 1863. *Fritillaria esculenta* Nutt. ex Baker, Jour. Linn. Soc.

- 14: 271. 1874. *F. lanceolata* var. *gracilis* Wats., Proc. Am. Acad.
 14: 259. 1879. *F. mutica* var. *gracilis* Jepson, Fl. Western Middle
 Calif. 188. 1901. *F. Lunellii* Nelson, Proc. Biol. Soc. Wash. 20:
 35. 1907. *F. lanceolata* var. *tristulis* Grant in Jepson, Fl. Calif. 1:
 308. 1921. *F. ojaiensis* Davidson, Bull. So. Calif. Acad. Sci. 21:
 41. 1922. *F. exima* Eastwood, Leaflets West. Bot. 2: 112. 1938.

Bulb of a few scales and rice-grain bulblets; stem 30–120 cm. long, very stout in taller plants; leaves in several whorls on upper part of stem, usually 3 to 5 in a whorl, ovate-lanceolate, 37.5–162.5 cm. long, 5–30 mm. wide; flowers nodding, 1 to 13, brownish-purple mottled with greenish-yellow, some flowers almost solidly purple, others faintly mottled and pale greenish-yellow; perianth segments 20–40 mm. long, 4–11 mm. wide, ovate to oblong; gland in center of segment, conspicuous, yellowish-green with minute purple dots; style cleft to the middle; capsule 1.6–2.5 cm. long, broadly winged; flowering from February to May.

Distribution. British Columbia to southern California in the fog belt of the coastal hills, mainly in oak and brush associations, but not with redwoods; also east into Idaho.

Type. Washington. "Brand Is., at foot of cascades, Columbia River." 1806, *Lewis*.

1806, *Lewis*.

Representative material. BRITISH COLUMBIA. New Westminster County: Whytecliffe, Howe Sound, *McCabe 2556*. Yale County: Pinantan, *McCabe 2411*. Vancouver Is., Victoria, 1909, *Anderson*. WASHINGTON. Clallam County: Duvall, *Knoke 290*. San Juan County: San Juan Is., Friday Harbor, *Peck 12625*. Island County: Camano Is., 1895, *Gardner*. Mason County: seashore near county line, *Jones 6513*. Thurston County: Hawks Prairie, *Johnson 509*. Lewis County: Cascade Mts., Goat Mts., *Allen 235*. Cowlitz County: Columbia River bluffs near Kalama, *Thompson 10128*. Whatcom County: Chuckanut Bay, 1890, *Suksdorf*. Skagit County: Fidalgo Is., Snee Oosh, *Mason 5305*. King County: Seattle, 1899, *Smith*. Pierce County: Tacoma, *Flett 3431*. Chelan County: Swauk Creek, Bleweet Pass, *Quick 1011*. Kittitas, Chelan and King counties: Cascade Mts., 1889, *Vasey*. Yakima County: Naches River, 1921, *Ihrig*. Klickitat County: Bingen, Falcon Valley [*sic*], *Suksdorf 312*. Okanogan County: Hidden Lakes, Ptarmigan Creek, *Edwards 264*. Spokane County: Liberty Lake, 1919, *Kunholz*. OREGON. Clatsop County: Saddle Mt., 1915, *Gorman*. Lane County: highway near Blue River, *Eastwood & Howell 1611*. Douglas County: South Umpqua River, Roseburg Quadrangle, 1914, *Cusick*. Curry County: Gold Beach, 1916, *Hoyt*. Josephine County: Selma, *Henderson 5793*. Jackson County: near summit Siskiyou Mts., 5 mi. north of California line, *Ownbey & Meyer 2168*. Hood River County: Hood River, *Whited 1126*. Wasco County: foothills of Mt. Hood, *Lunell* (type of *F. Lunellii*). CALIFORNIA. Del Norte County: Crescent City, *East-*

wood 49. Siskiyou County: Hilt, 1917, *Stonehouse*. Humboldt County: Kosbell, Hungry Hollow, 1925, *Kildale*. Trinity County: Weaverville, 1915, *Jenkans*. Tehama County: coast range near Bennett Spring, 1918, *Heller*. Mendocino County: Mendocino City, 1932, *Peterson*. Butte County: Pence Grace, east of Paradise, 1932, *Morrison* (type of *F. exima*). Lake County: Kelseyville, *Irwin* 101. Sonoma County: Mt. St. Helena, Middletown grade, *Jepson* 14823. Napa County: Calistoga, 1915, *Eastwood*. Marin County: Mt. Tamalpais, Cataract Gulch, *Grant* 930. Solano County: Vacaville, 1898, *Platt*. Contra Costa County: Briones Valley, *Chandler* 577. San Francisco County: Bernal Heights, San Francisco, *Mason* 1268. Alameda County: Berkeley, Grizzly Peak, *Davy* 118. San Mateo County: Crystal Springs Lake, *Baker* 5047. Santa Cruz County: Glenwood, 1907, *Davis*. Santa Clara County: Mt. Hamilton Range, Red Mts., Colorado Creek, *Beetle* 16. Stanislaus County: Mt. Hamilton Range, Red Mts., Adobe Creek, *Sharsmith* 3577. Monterey County: Del Monte Heights, 1914, *Woodcock*. San Benito County: New Idria, Cantua Creek, 1893, *Kellogg* (type of *F. viridea*). San Luis Obispo County: Pismo, Pismo Creek, *Munz* 9253. Riverside County: San Bernardino Mts., 1876, *Lemmon*. IDAHO. Kootenai County: north shore Lake Coeur d'Alene, *Hitchcock* & *Samuel* 2618. Benewah County: Chatcolet, *Warren* 888.

17. FRITILLARIA ATROPURPUREA Nutt. Jour. Acad. Phil. 7: 54. 1834. *F. alba* Nutt. Gen. Am. Pl. 1: 222. 1818, *nomen confusum*. *F. gracillima* Smiley, Univ. Calif. Publ. Bot. 9: 143. 1921.

Bulb of few thin scales; stem 15–65 cm. long; leaves linear, 7 to 14, alternate to whorled, scattered, 6.25–8.75 cm. long, 1.5–4 mm. wide; flowers 1 to 4, or as many as 12, open campanulate, nodding, brown spotted with yellow and white; perianth segments rhomboid or oblong, tapering abruptly to the base, a tuft of yellow hairs at the apex, 9–21 mm. long, 2–8 mm. wide; gland an indistinct brownish-yellow area at base of segment; style cleft two-thirds to three-fourths its length; capsule 9–17 mm. long, acutely angled; flowering from April to July.

Distribution. Idaho to the Dakotas and Nebraska, south to New Mexico (*n.v.*), west to California and Oregon.

Type. "Flathead River, N. Rocky Mountains," *Nuttall*.

Representative material. OREGON. Grant County: Blue Mts., *Henderson* 5398. Harney County: Steins Mts., Sheep Camp, *Henderson* 8836. CALIFORNIA. Siskiyou County: Marble Mt., *Jepson* 2831. Trinity County: Scott Mts., north of Carrville, *Eastwood* & *Howell* 4989. Shasta County: Soupan Springs, *Hall* & *Babcock* 4304. Modoc County: Warner Mts., Lost Lake, *Schreiber* 1174. Plumas County: Portola, *Eastwood* 6992. Butte County: Humboldt Summit above Jonesville, *Ownbey* & *Ownbey* 1733. Placer County: Lake Tahoe, Deer, *Eastwood*, 407. Alpine County: Ebbett

Pass, *Beetle* 3778. Tuolumne County: Tuolumne Meadows, 1917, *Miller*. Mariposa County: Mormon Bar, *Congdon*. Fresno County: Pittman Creek, *Grant* 1061. Madera County: Yosemite Park, Mt. Lyell, *Hall & Babcock* 3562 (type of *F. gracillima*). Tulare County: Upper Marble Fork of Kaweah River, *Hopping* 312. IDAHO. Owyhee County: Silver City, *Macbride* 910. Lemhi County: Shoup, 1936, *Blair*. Custer County: Patterson, *Hitchcock et al.* 3757. Clark County: Spencer, Little Dry Creek Canyon, *Rust* 726. Bannock County: Pocatello, *Donaghe* 112. NEVADA. Washoe County: Verdi, 1899, *Sonne*. Elko County: Ruby Valley near Cave Creek Post Office, *Mason* 4705. White Pine County: Warm Springs, 1918, *King*. Clark County: Charleston Mts., Charleston Park, Rainbow Falls, *Alexander* 630. UTAH. Juab or Millard County: Fish Spring Mts., 1904, *Jones*. Iron County: Cedar City, *Jones* 5397W. Piute County: Marysville, *Jones* 3368. Kane County: Zion Park, 3 mi. east of east entrance, *Hitchcock* 2974. San Juan County: Navajo Mt., War God Spring, *Benson* 177. County uncertain: east central Utah, mouth of Green Canyon, *Maguire & Burke* 5150; Pharsolis Glenn, 1911, *Clemens*. ARIZONA. Coconino County: Grand Canyon of Colorado River, Grand View Hotel, *Eastwood* 5794. Gila County: Matzatzal Mts., North Peak, *Collom* 131. MONTANA. Gallatin County: Bozeman, *Jones* 54. WYOMING. Yellowstone Park, Glen Creek, *Nelson* 5612. Teton County: Grand Teton Park, Cascade Canyon, *Williams* 1137. Crook County: Hulett, *Ownbey* 591. COLORADO. Gunnison County: Gunnison watershed, Poverty Ridge near Cimarron, *Baker* 128. NORTH DAKOTA. McKenzie County: south part, T. 45, R. 102, 1938, *Moran*. SOUTH DAKOTA. Pennington County: near Deerfield, *Palmer* 37498. NEBRASKA. Dawes County: White River Valley near Bad Lands, on Eagle's Nest Butte, 1855, *Hoyden*.

Fritillaria alba is a *nomen confusum*. Nuttall's description is mainly that of a *Fritillaria*. The range given, however, lies far outside that of any species of *Fritillaria* except *F. atropurpurea* which the description does not fit. Ownbey attributes it in part to *Calochortus Nuttallii*.

17a. FRITILLARIA ATROPURPUREA var. PINETORUM (Davids.) Johnston, *Plant World* 22: 84. 1919. *F. pinetorum* Davids. *Muhlenbergia* 4: 67. 1908.

Bulb of thin scales and with rice-grain bulblets; stem 20–50 cm. long, usually stout; leaves 5–15 cm. long; 2–7 mm. wide; flowers 3 to 9, sometimes 11, mottled as in the species; segments 14–19 mm. long, 2–6 mm. wide; pedicels usually erect; capsule acutely angled, sometimes with short horn-like processes at base and summit of each valve; flowering from June to July.

Distribution. California from Alpine County to San Bernardino County, extending into Nevada; exposed slopes at 6000–10,500 feet elevation.

Type. California, Kern County, "Mt. Cummings, Tehachapi range," *Hasse & Davidson 1739*.

Representative material. CALIFORNIA. Alpine County: Carson Pass, *Eastwood & Howell 8423*. Mono County: Hot Springs, Casa Diablo, *Baker 9089*. Fresno County: North Fork of Kings River, Long Meadow, *Hall & Chandler 4421½*. Tulare County: Mt. Moses, *Purpus 1339*. Kern County: Greenhorn Mts., near Pine Flat, *Weston 679*. Ventura County: Mt. Pinos, *Munz 7029*. San Bernardino County: San Antonio Mts., Swarthout Canyon, *Hall 1507*.

EXCLUDED NAMES

Fritillaria alba Nutt. Gen. N. Am. Pl. 1: 222. 1818, *nomen confusum*.

Fritillaria barbata H.B.K. Nov. Gen. et Sp. Pl. 1: 288. 1816; *ibid.* 7: t. 677. 1825 = *Calochortus barbatus* Painter.

Fritillaria cuprea R. Graham, Edinb. New Phil. Jour. (Jan. 1836) 192 = *Calochortus barbatus* Painter.

Fritillaria linearis Coult. and Fisher, Bot. Gaz. 18: 352. 1892. Type probably from Black Hills of Dakota. The name of the collector has been lost and the type could not be located. No specimens answering to the description have since been collected.

Fritillaria purpurea H.B.K. Nov. Gen. et Sp. Pl. 1: 288. 1816 = *Calochortus purpureus* (H.B.K.) Baker.

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University of California, Berkeley,
March, 1943.

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THE HOMONYM QUESTION

LEON CROIZAT

To close in a constructive vein the discussion about homonyms which has taken place in these pages, I owe the reader certain facts. Mr. A. Cronquist and Mr. C. A. Weatherby are correct in pointing out (*Madrono* 7: 83. 1943) that an earlier homonym—in the sense of Article 61 of the International Rules of Botanical Nomenclature—can be only a name which is validly published. Validity in publication, consequently, is essential to an homonym, for without it there is no homonymy.

This being the case, I point out that: (1) In the "Proposals of the British Botanists" (*Intern. Bot. Congr. Cambridge* 1930: 43. 1929) nothing is said about validity. (2) In the discussion that led to the adoption of Art. 61 (*Rept. Proc. Intern. Bot. Congr. Cambridge* 600-604, 1931) the discussion never touched upon the validity of an earlier homonym. (3) In her authoritative comment on the Cambridge Rules (*in Emp. For. Jour.* 10: 68. 1931) Miss M. L. Green said nothing about validity.

The meaning of an Article in the Rules is to be read in the text of the Article, which I will not deny. However, Art. 61 lays down validity as the fundamental requirement of homonymy. It is strange that this requirement should not be mentioned at all in the antecedents and comments written upon this Article. This omission should be understood in the light of the fact that meaningless or confusing additions are known to have been introduced into the Rules beyond the intentions of the proponents of certain Articles (Croizat, *Bull. Torrey Club* 70: 322. 1943).

It is evident, therefore, that by insisting upon validity of publication, Article 61 leaves completely unsettled the state of the legion of names commonly understood as *nomina subnuda*, *nomina abortiva*, and the like. The prime necessity of providing for these doubtful entities in nomenclature was quite clear to A. DeCandolle

(Lois. Nom. Bot., Art. 45, 46—Commentaires 45. 1867), and certainly was in the minds of those who wrote that Article 61 was intended to provide for names "published . . . with a description (or references to a former description)." By steering clear of the morass of what is *valid*, the Proposal just quoted was far better than Article 61 itself, which does not work in any case involving names of doubtful publication. It is not correct to state that validity and legitimacy are clear concepts. Without further entering into the matter, I may point out that Handel-Mazzetti proposed the outright cancellation of Article 61 (Fedde Rep. Sp. Nov. 46: 91. 1939) mainly on the ground that it was not clear in its definitions, and was ruinous in actual practice. I do not wholly agree with Handel-Mazzetti to the full, but his testimony, as such, is valuable here.

My very definite opinion was, and still is, that the adjective *valid* was not meant to be written in Article 61 and that for the good of taxonomy it should be removed. A formal proposal to this effect, with an appropriate discussion and examples, will be submitted to the Botanical Congress in due time.

Arnold Arboretum,
Jamaica Plain, Massachusetts,
August, 1943.

NOTES AND NEWS

A NEW NAME IN SCIRPUS. *Scirpus orbicephala* nom. nov. *Holoschoenus mexicanus* Palla, Oesterr. Bot.-Zeitschr. 63: 40. 1913. Not *Scirpus mexicanus* Clarke in Britton, Trans. N. Y. Acad. Sci. 11: 77. 1892. Subgenus *Euscirpus*. Section *Anosporum*. Mexico: Flor de Maria, Pringle 3173; Huerta, Loma Santa Maria, and Cerro Azul, *Arsenius*. Although described under the genus *Holoschoenus*, now a section of *Scirpus*, the species *H. mexicanus* Palla is recognized as belonging to the genus *Scirpus*, section *Anosporum*. A. A. BEETLE, Division of Agronomy, University of California, Davis.

Word was received on December 20, 1943, that Dr. W. Palmer Stockwell of the California Forest Experiment Station of the United States Forest Service had arrived in Lisbon, Portugal. With a representative of the Crown Cork and Seal Company, Dr. Stockwell expects to spend several months in the Mediterranean region. They will visit nurseries and plantations in Portugal, Spain, Spanish Morocco, Algiers and Tunisia in addition to making a study of the native habitat of the cork oak. In collaboration with the Crown Cork and Seal Company, the Forest Service plans to bring back several tons of seed from select cork oak trees and carry on further experimentation in this country in the hope of developing a successful cork oak industry here.